

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

Appellants: T. KUTSUNA, et al.  
Application. No. 10/602,637  
Filed: June 25, 2003  
For: FUEL SYSTEM HAVING EXCELLENT GASOLINE BARRIER  
PROPERTY  
Group AU: 1794  
Examiner: Marc A. Patterson  
Confirm. No.: 1073

**BRIEF ON APPEAL**

**Mail Stop: APPEAL BRIEF**

Honorable Commissioner of  
Patent and Trademarks  
P.O. Box 1450  
Alexandria, VA 22313-1450

June 10, 2009

Sir:

This Appeal is from the Decision of the Examiner in the Office Action mailed  
December 10, 2008, finally rejecting claims 1, 2, 6 and 8-25.

(i) **REAL PARTY IN INTEREST**

The real party in interest for the above-identified application is Mitsubishi Gas Chemical Company, Inc., by Assignment recorded on June 25, 2003, at Reel 014229, Frame 0282.

(ii) **RELATED APPEALS AND INTERFERENCES**

Upon information and belief, there are no other prior and/or pending appeals, interferences, or judicial proceedings known which may be related to, directly affect or be directly affected by or have a bearing on a decision in this appeal by the U.S. Patent and Trademark Office Board of Patent Appeals and Interferences.

(iii) **STATUS OF CLAIMS**

The claims presently on appeal are claims 1,2, 6 and 8-25. No claim is allowed. Claims 3-5 and 7 have been previously cancelled without prejudice or disclaimer.

(iv) **STATUS OF AMENDMENTS**

No amendments to the claims have been made subsequent to the Final Office Action mailed December 10, 2008.

Subsequent to this Final Office Action mailed December 10, 2008, a Request for Reconsideration After Final Rejection was filed March 10, 2009.

While in the Advisory Action mailed March 23, 2009, the Examiner indicated both that the proposed amendments filed after a final rejection, but prior to the date of filing a brief, will not be entered, and that for purposes of appeal, the proposed amendments will be entered, in fact no amendments to the claims were made after final rejection; only the aforementioned Request for Reconsideration After Final Rejection has been filed after the Final Office Action mailed December 10, 2008.

While the Examiner does not indicate on the first page of the Advisory Action mailed March 23, 2009, that the Request for Reconsideration filed March 10, 2009, has been considered, on page 2 of this Advisory Action mailed March 23, 2009, the Examiner indicates that Applicants' arguments filed March 10, 2009, have been fully considered.

Accordingly, the claims presently on appeal are claims 1, 2, 6 and 8-25, with claims 3-5 and 7 having been cancelled without prejudice or disclaimer, and with no claims standing allowed in the above-identified application.

(v) **SUMMARY OF CLAIMED SUBJECT MATTER**

Claim 1, the only independent claim in the application, is directed to a fuel system that includes a fuel vessel, molded parts for the fuel vessel, and/or a tube for a fuel in which bodies thereof are constituted from a thermoplastic resin and/or a rubber. See pages 9-17 of Appellants' specification. Hereinafter, where each of the fuel vessel, molded parts and/or a tube for a fuel are being discussed, they will be called a fuel system component.

Claim 1 further recites a coating layer formed on the surfaces of the inside and/or outside of the fuel system component, or a connected part thereof. This coating layer is further defined in the remainder of claim 1, this coating layer being defined as being formed by curing an epoxy resin composition comprising an epoxy resin and an epoxy resin curing agent as principle components, with this coating layer, which is a barrier layer for gasoline, having a gasoline permeability coefficient of  $2 \text{ g}\cdot\text{mm}/\text{m}^2\cdot\text{day}$  or less at  $60^\circ\text{C}$  and a relative humidity of 60% RH. See, for example, the sole full paragraph on page 7 of Appellants' specification; note also from page 41, line 5, to page 43, line 3, of Appellants' specification, and the first full paragraph on page 17 thereof.

The epoxy resin of this epoxy resin composition is defined in claim 1 as at least one selected from an epoxy resin having a glycidylamine part derived from metaxylylenediamine, and an epoxy resin having a glycidylamine part derived from 1,3-bis(aminomethyl)-cyclohexane. See pages 18-21 of Appellants' specification, also describing that these epoxy resins achieve a high gasoline barrier property.

The epoxy resin curing agent forming part of the epoxy resin composition from which the coating layer is formed is defined as a reaction product of (A) and (B), or a reaction product of (A), (B), and (C), where:

(A) is metaxylylenediamine or paraxylylenediamine;

- (B) is a multifunctional compound having at least one acyl group which can form an amide group part by reacting with polyamine to form an oligomer, the multifunctional compound being selected from the group consisting of acrylic acid, methacrylic acid, and derivatives of acrylic acid, methacrylic acid, maleic acid, fumaric acid, succinic acid, malic acid, tartaric acid, pyromellitic acid and trimellitic acid; and
- (C) is a monovalent carboxylic acid having 1-8 carbon atoms and/or a derivative thereof.

See pages 23 and 24 of Appellants' specification, also disclosing selection of these curing agents considering the high gasoline barrier property, good adhesiveness of the coating layer to various materials, flexibility and heat resistance.

Claim 1 further recites that the coating layer contains a skeletal structure represented by the formula (1), set forth on page 18 of Appellants' specification. As described on this page 18, a good gasoline barrier property is revealed by controlling the skeletal structure of general formula (1) in the coating layer to be 30% by weight or more.

As described in the paragraph bridging pages 6 and 7 of Applicants' specification, by providing a fuel system as in the present claims, having the fuel vessel body of a thermoplastic resin and/or a rubber and having the above-described coating layer, structure is provided which is excellent in a gasoline barrier property, a heat resistance and an impact resistance, and has high profitability.

Claims 9, 12, 15 and 18, each dependent on claim 1, respectively defines the coating layer on surfaces of a fuel vessel body, molded part bodies, a tube body and connected parts.

The other claims in the application on appeal, claims 2, 6, 8-11, 13, 14, 16, 17 and 19-25, all directed to a fuel system, are dependent either directly or through

intermediate claims on claim 1. Of these dependent claims, claims 2 and 24, each dependent on claim 1, further define the gasoline permeability coefficient of the coating layer, consistent with the description in the first full paragraph on page 17 of Appellants' specification. Claims 6 and 23, each dependent on claim 1, further define the epoxy resin, respectively as the resin having a glycidylamine part derived from metaxylylenediamine as a principal component, and having a glycidylamine part derived from 1, 3-bis(aminomethyl)-cyclohexane. Claim 25, dependent on claim 1, defines a number average molecular weight of the epoxy resin, consistent with the description in the second paragraph on page 21 of Appellants' specification.

Claim 9, dependent on claim 1, in addition to its recitation of a fuel vessel body, recites the extent to which the coating layer is formed on any surface of the inside and outside of the fuel vessel body, consistent with the description in the second full paragraph on page 29 of Appellants' specification; and claims 10 and 11, dependent respectively on claims 9 and 10, further define the thermoplastic resin constituting the fuel vessel body, consistent with the description in the paragraph bridging pages 9 and 10 of Appellants' specification. Similarly, note claims 13, 14 and 16, dependent respectively on claims 12, 13 and 15, further defining the thermoplastic resin.

Claims 8, 17 and 19-22 further define the coating layer of the claimed fuel system. Claim 8, dependent on claim 1, further defines the multifunctional compound (B), consistent with the description in the paragraph bridging pages 23 and 24 of Appellants' specification; and claims 17 and 20, dependent on claim 1, recite a blending proportion of the epoxy resin curing agent to the epoxy resin in the epoxy resin composition of the coating resin layer, consistent with the description in the paragraph bridging pages 26 and 27 of Appellants' specification. Note that with this blending ratio, a reduction in gasoline barrier property of the resulting cured



layer, due to remaining unreacted epoxy groups, can be avoided, while a reduction in moisture and heat resistance, and acid resistance, of the resulting cured layer, due to remaining unreacted amino groups, can be avoided.

Claim 19, dependent on claim 1, recites a mole ratio of the components (A) to (B), or (A) to (B) and (C), of the epoxy resin curing agent, consistent with the description in the paragraph bridging pages 24 and 25 of Applicants' specification. By providing this mole ratio, a sufficient amount of amide groups is produced in the epoxy resin curing agent such that the gasoline barrier property is of a high level and sufficient adhesive properties are achieved, while a decrease in the amount of amino groups reacted with the epoxy resin is avoided, so that excellent impact resistance and heat resistance are achieved.

Claim 21, dependent on claim 1, recites a thickness of the coating layer, consistent with the description in the first full paragraph on page 29 of Appellants' specification, providing a coating layer having satisfactory gasoline barrier properties while providing a coating layer whose film thickness can easily be controlled.

(vi) **GROUND OF REJECTION TO BE REVIEWED ON APPEAL**

A first ground of rejection presented for review is the rejection of claims 1, 2, 6, 8-22, 24 and 25 under 35 U.S.C. §103(a) as being unpatentable over the teachings of the U.S. patents to Gerdes, et al. (No. 4,719,135) in view of Tashiro, et al. (No. 3,704,229) and Huang, et al. (No. 3,683,044).

A second ground of rejection presented for review is the rejection of claim 23 under 35 U.S.C. §103(a) as unpatentable over the teachings of the U.S. patents to Gerdes, et al. (No. 4,719,135) in view of Tashiro, et al. (No. 3,704,229) and Watanabe, et al. (No. 5,474,853).

(vii) **ARGUMENTS**

**Rejection of Claims 1, 2, 6, 8-22, 24 and 25 Under 35 U.S.C. §103(a) As Unpatentable Over The U.S. Patents to Gerdes, et al. (No. 4,719,135) In View Of Tashiro, et al. (No. 3,704,229) and Huang, et al. (No. 3,683,044)**

It is respectfully submitted that the teachings of the prior art as applied by the Examiner, that is, the teachings of the U.S. patents to Gerdes, et al., No. 4,719,135, to Tashiro, et al., No. 3,704,229, and to Huang, et al., No. 3,683,044, would have neither taught nor would have suggested the presently claimed subject matter in claims 1, 2, 6, 8-22, 24 and 25.

In particular, and as will be shown infra, it is respectfully submitted that the Tashiro, et al., and Huang, et al. references, which do not disclose or suggest materials for fuel systems as in the present claims, would not have been properly combinable with the teachings of Gerdes, et al., being directed to different technologies than that of Gerdes, et al. and not addressing problems addressed by the present invention which is directed to fuel systems; and it is respectfully submitted that there would have been no proper reason for combining the teachings of the references as applied by the Examiner, absent hindsight use of Appellants' disclosure, improper under the guidelines of 35 U.S.C. §103.

In any event, even assuming, arguendo, that the teachings of the three applied references were properly combinable under 35 U.S.C. §103, it is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such a fuel system as in the present claims, having the coating layer as recited in claim 1, the coating layer being formed by coating an epoxy resin composition comprising (a) an epoxy resin and (b) an epoxy resin curing agent as principal components, (1) wherein the coating layer is a barrier layer for gasoline and has a gasoline permeability coefficient of  $2 \text{ g} \cdot \text{mm}/\text{m}^2 \cdot \text{day}$  or less at  $60^\circ\text{C}$  and a relative humidity of 60% RH; (2) wherein the epoxy resin includes at

least one selected from an epoxy resin having a glycidylamine part derived from metaxylylenediamine, and an epoxy resin having a glycidylamine part derived from 1, 3-bis(aminomethyl)-cyclohexane; (3) wherein the epoxy resin curing agent comprises a reaction product of the following (A) and (B) or a reaction product of the following (A), (B) and (C):

- (A) metaxylylenediamine or paraxylylenediamine;
- (B) a multifunctional compound having at least one acyl group which can form an amide group part by reacting with polyamine to form a oligomer, the multifunctional compound being selected from the group consisting of acrylic acid, methacrylic acid, and derivatives of acrylic acid, methacrylic acid, maleic acid, fumaric acid, succinic acid, malic acid, tartaric acid, pyromellitic acid and trimellitic acid; and
- (C) monovalent carboxylic acid having 1-8 carbon atoms and/or a derivative thereof;

and (4) wherein the coating layer contains the skeletal structure of formula (1), at least in an amount of 30% by weight based on the weight of the coating layer. See claim 1.

It is respectfully submitted that the combined teachings of the references as applied by the Examiner do not disclose, nor would have suggested, the combination of the features of (1)-(4) in claim 1, set forth above, providing unexpected advantages of unexpectedly low gasoline permeability coefficient while having good mechanical properties as a structure of a fuel system. Note that these features (1)-(4) include metaxylylenediamine or paraxylylenediamine being a reactant in forming the epoxy resin curing agent recited in the present claims.

Moreover, it is respectfully submitted that even assuming, arguendo, that the teachings of the applied references would have established a prima facie case of

obviousness, the evidence of record in the above-identified application overcomes such prima facie case of obviousness, and establishes unobviousness of the presently claimed invention. As for the evidence relied on, discussed infra, note the evidence in Appellants' specification, that is, the Examples and Comparative Examples, on pages 43-50 of Appellants' specification (a copy of these pages being set forth in the "Evidence Appendix" of this Brief), as well as the evidence in the Declaration Under 37 CFR 1.132 submitted with the Amendment filed September 2, 2008 (a copy of which is also in the "Evidence Appendix" of this Brief).

Clearly, the evidence in Appellants' specification must be considered in determining obviousness. See In re DeBlauwe, 222 USPQ 191 (CAFC 1984). Note also Manual of Patent Examining Procedure (MPEP) 716.01(a), stating that Examiners must consider comparative data in the specification which is intended to illustrate the claimed invention, in reaching a conclusion with regard to the obviousness of the claims, citing In re Margolis, 785 F.2d 1029, 228 USPQ 940 (CAFC 1986).

Although Appellants have clearly relied on evidence in their specification (note, for example, pages 5 and 6 of the Request for Reconsideration filed March 10, 2009, and page 12 of the Amendment filed September 2, 2008), the Examiner has never commented upon such evidence, apparently ignoring such evidence. Such apparent failure to consider this evidence in Appellants' specification is clear error; and in proper consideration of the evidence in Appellants' specification, as well as consideration of the evidence in the aforementioned Declaration, it is respectfully submitted that Appellants have clearly overcome any possible prima facie case of obviousness established by the combined teachings of the applied references.

In connection with the submitted evidence, attention is respectfully directed to the Declaration Under 37 C.F.R. §1.132 of S. Yonehama submitted with the

Amendment filed September 2, 2008. Note particularly the Additional Comparative Examples described therein, utilizing the curing agent of Tashiro, et al., prepared according to Example 1 of the Tashiro, et al. reference. Additional Comparative Example 1 provides a coating layer utilizing the curing agent of Tashiro, et al. together with an epoxy resin Epikote 828, providing a coating layer, after curing, of 10  $\mu\text{m}$ . A gasoline permeability coefficient of the coated film thus obtained was determined.

Additional Comparative Example 2 of the aforementioned Declaration provided an acrylonitrile-butadiene rubber tube according to Example 4 of the above-identified application, with a coating film being formed therein to have a thickness of 10  $\mu\text{m}$ . The tube in which the coating layer was formed was evaluated for a gasoline barrier property, and a gasoline barrier property after bending.

The results of Additional Comparative Examples 1 and 2 are shown in Table A of the Declaration submitted with the Amendment filed September 2, 2008, on page 3 thereof, together with results from Examples 1 and 4 of Appellants' specification (see Tables 1 and 2 on pages 45 and 50, respectively, of Appellants' specification). As can be seen, the gasoline permeability coefficient according to the present invention, as well as gasoline permeability of a tube and of the tube after bending, was unexpectedly lower according to the present invention, as compared to results in Additional Comparative Examples 1 and 2. It is respectfully submitted that this Declaration, and the Examples 1 and 4, show unexpectedly better results achieved according to the present invention, utilizing the combination of epoxy resin and epoxy resin curing agent according to the present invention, as compared to the combination of curing agent of Tashiro, et al. together with the epoxy resin described therein and in Gerdes, et al. Comparisons of the present invention with coating layers as in Additional Comparative Examples 1 and 2 test use of curing agents

outside the scope of the present claims, even closer than those of the closest prior art, i.e., Gerdes, et al., and thus constitute a proper test for establishing unexpectedly better results achieved by the presently claimed invention. It is respectfully submitted that this evidence of unexpectedly better results as compared to, e.g., structure formed using a curing agent of Tashiro, et al., but outside of those within the scope of the present claims, sufficiently rebuts any prima facie case of obviousness arising from the teachings of the applied references.

Such evidence of unexpectedly better results is further supported from the evidence in Appellants' specification, in particular, the Examples and Comparative Examples in Table 1 on page 45, showing results from Examples 1-3 and Comparative Example 1 on pages 43-45; and in Table 2 on page 50 of Appellants' specification, showing results from Examples 4-8 and Comparative Examples 2-4 on pages 45-49 of Appellants' specification. Note particularly Comparative Example 4, on pages 49 and 50, as compared with Example 4 on pages 45-47, of Appellants' specification. It is respectfully submitted that this evidence in Appellants' specification must be considered in determining patentability, in addition to consideration of the Declaration submitted September 2, 2008; and that, properly considered, all evidence of record, set forth in the "Evidence Appendix" of this Brief, rebuts any possible prima facie case of obviousness established by the teachings of the applied references.

In the first paragraph on page 7 of the Office Action mailed December 10, 2008, the Examiner contends that the aforementioned Declaration "does not compare the claimed invention to the closest prior art". However, the data in the aforementioned Declaration provides test data using an epoxy resin curing agent even closer to the present invention than the curing agent of the closest prior art, i.e., Gerdes, et al., and thus constitutes a proper test. Note that the combination of

curing agent used in the Declaration, from Example 1 of Tashiro, et al., and disclosed in columns 1 and 2 of Tashiro, et al., was used in light of the full disclosure of Tashiro, et al., including the Examples (note columns 3 and 4 of this patent) and the "(II) PAINT TEST" thereof, in columns 4 and 5 of this patent. Moreover, note that as the Examples of each of Tashiro, et al. and of Gerdes, et al. used Epikote 828, such epoxy resin was used in the Additional Comparative Example 2 of the aforementioned Declaration. It is respectfully submitted that taking the teachings of Tashiro, et al. and of Gerdes, et al. as a whole, selection of Epikote 828 is appropriate in connection with the closest prior art.

In addition, note that Gerdes, et al., in column 2, lines 59-64, describes that epoxy resins particularly suitable for the fuel impervious polymeric article described therein are, for example, those currently sold under the trade names Epikote 828, EER 331 and Rutapox 0164, the most preferred being a liquid diglycide ether prepared from epichlorohydrin and diphenylpropane (bisphenol A). Note that Epikote 828 is prepared from epichlorohydrin and diphenylpropane (bisphenol A).

In view of the foregoing, it is respectfully submitted that Epikote 828 was appropriately used in the aforementioned Declaration, forming part of the closest prior art.

Moreover, as set forth in the aforementioned Declaration, the reaction product used as a curing agent in this Declaration was obtained from Components A, B and C of Tashiro, et al., different from a curing agent of the present invention. It is respectfully submitted that this curing agent utilized in the aforementioned Declaration is appropriately used in a comparison of the present invention with the closest prior art, being closer to the present invention than the curing agents disclosed in Gerdes, et al.



The contention by the Examiner in the first paragraph of page 7 of the Office Action mailed December 10, 2008, that Tashiro, et al. is not limited to Example 1, and that Tashiro, et al. is also not limited to the curing of Epikote 828, is noted. It is respectfully submitted, however, that Applicants need not compare the present invention with each and every embodiment within the scope of the prior art. Noting the foregoing, and particularly the disclosure in Gerdes, et al. that “particularly suitable epoxy resins” include Epikote 828, with the “most preferred” being a liquid diglycide ether prepared from epichlorohydrin and diphenylpropane (bisphenol A), which corresponds to Epikote 828, it is respectfully submitted that the tests utilizing Epikote 828 constitute a fair test with an epoxy resin of the closest prior art.

The additional contention by the Examiner, in the second and third paragraphs on page 7 of the Office Action mailed December 10, 2008 (in response to Appellants’ argument that unexpectedly better results are obtained using the claimed epoxy resin and epoxy resin curing agent), that the combination of Gerdes, et al., Tashiro, et al. and Huang, et al. discloses the skeletal structure, as the claimed epoxy and curing agent are disclosed, is noted. It must be emphasized, however, that Appellants need not compare their invention with a combination of teachings of references. That is, as stated in MPEP 716.02(e), subheading III (“THE CLAIMED INVENTION MAY BE COMPARED WITH THE CLOSEST SUBJECT MATTER THAT EXISTS IN THE PRIOR ART”), “applicant is not required to compare the claimed invention with subject matter that does not exist in the prior art”. That is, it is respectfully submitted that the evidence of record, including (but not limited to) the aforementioned Declaration, provides a fair test with subject matter closer than the closest prior art, showing unexpectedly better results in reduced gasoline permeability coefficient, as well as gasoline permeability before and after bending, achieved by the present invention as compared with the closest prior art.

In addition, attention is again directed to the evidence in Appellants' specification, apparently ignored by the Examiner in considering obviousness of the presently claimed subject matter. Note Example 4 on pages 45-47 of Appellants' specification, and Comparative Example 4 on pages 49 and 50, with results shown in Table 2 on page 50. It is respectfully submitted that this evidence shows unexpectedly advantageous (reduced) gasoline permeability of structure within the scope of the present invention, as compared with that of Comparative Example 4.

The additional contention by the Examiner, in the second full paragraph on page 9 of the Office Action mailed December 10, 2008, that Tashiro, et al. discloses in column 1, line 63, and column 2, line 14, a reaction product of metaxylylenediamine and acrylic acid derivative, as claimed, which reaction product apparently should be used in any comparative test, is respectfully traversed. Initially, as the closest prior art is Gerdes, et al., the primary applied reference, Appellants need not provide a comparison with Tashiro, et al. as implied by the Examiner for a comparison with the closest prior art.

Moreover, note that Tashiro, et al. requires, as the curing agent, a reaction product of each of components A, B and C thereof. The aforementioned Declaration uses a curing agent for the Additional Comparative Example using not only Example 1 of Tashiro, et al., but also in light of the disclosure from column 1, line 59, to column 2, line 16, of Tashiro, et al. It is again emphasized that Applicants provide in the aforementioned Declaration structure formed utilizing the closest prior art, i.e., Gerdes, et al., with an even closer curing agent than that in Gerdes, et al., i.e., within the scope of Tashiro, et al. but outside the scope of the present claims. It is respectfully submitted that Appellants' need not compare the claimed invention with subject matter that does not exist in the prior art, i.e., a combination of teachings of references, as apparently being required by the Examiner in referring to a reaction

product of metaxylylene and acrylic acid derivative from the teachings of Tashiro, et al. Note the second full paragraph on page 9 of the Office Action mailed December 10, 2008.

In addition, it is noted that Tashiro, et al. discloses only a 70:30 mixture of metaxylylenediamine and paraxylylenediamine, and the curing agent is obtained by addition and condensation reaction of three components A, B and C. It is respectfully submitted that one of ordinary skill in the art would understand that the reaction product of Tashiro, et al. is completely different from the reaction products of present claim 1, utilized as the curing agent.

The contention by the Examiner in the last paragraph on page 2 of the Advisory Action mailed March 23, 2009, that the closest prior art also includes Huang, et al., is noted. It is clear therefrom that the Examiner has treated as the closest prior art a combination of teachings of separate references. In contrast, in considering evidence of unexpected results, the closest prior art to be considered is a single reference. Clearly, the Examiner has provided an incorrect test in his consideration of unexpectedly better results, considering a combination of teachings of the references; and upon a proper consideration, which is a comparison with the closest single prior art reference, the evidence of record, including (1) the evidence in Appellants' specification, and (2) the submitted Declaration, Appellants have clearly established unexpectedly better results achieved by the presently claimed invention, and, accordingly, unobviousness thereof.

Furthermore, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such a fuel system as in the present claims, having features as discussed previously in connection with claim 1, and, moreover, in particular wherein the epoxy resin

includes the resin having a glycidylamine part derived from metaxylylenediamine as a principal component (see claim 6).

Moreover, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such fuel system as in the present claims, having features as discussed previously in connection with claim 1, and, additionally, wherein the gasoline permeability coefficient is  $0.2 \text{ g}\cdot\text{mm}/\text{m}^2\cdot\text{day}$  or less (see claim 2), or, more specifically,  $0.02 \text{ g}\cdot\text{mm}/\text{m}^2\cdot\text{day}$  or less (see claim 24); and/or wherein the number average molecular weight of the epoxy resin is in a range of 80-400 (see claim 25); and/or wherein the multifunctional compound (B) reacted in forming the epoxy resin curing agent is acrylic acid, methacrylic acid and/or a derivative thereof (see claim 8); and/or wherein the coating layer is formed at an area rate of 50-100% (see claim 9); and/or wherein the thermoplastic resin is a polyolefin resin (see claims 10 and 13), in particular a polyethylene resin (see claims 11 and 14); and/or wherein the thermoplastic resin is at least one selected from a polyolefin resin, a polyurethane resin, a polyethylene resin, a polyester resin and acryl resin, and a vinyl resin which have flexibility (see claim 16); and/or a blending ratio of the epoxy resin curing agent to the epoxy resin, as in claims 17 and 20; and/or the reaction mole ratio of (A) to (B), or (A) to (B) and (C), being within a range of 0.3-0.97, in terms of number of amino groups in (A) to the number of reactive functional groups in (B), or number of amino groups (A) to total number of reactive functional groups (B) and (C), as in claim 19; and/or the thickness of the coating layer being 1-200  $\mu\text{m}$ , as in claim 21.

The present invention is directed to a fuel system which includes at least one of various components such as, for example, a fuel vessel, molded parts for the fuel vessel and a tube for a fuel. In particular, the present invention is directed to such fuel system having excellent performance in preventing permeation of, e.g., gasoline,

while having good heat resistance and impact resistance, and bendability, without deterioration in preventing permeation of the gasoline.

In recent years, use has been made of thermoplastic resins in fuel systems, as compared with use of metal, providing advantages of a reduction in weight, prevention of rust, ease in molding and ability to be recycled. However, in previously proposed fuel systems, various performances, such as heat resistance, water resistance, impact resistance, and avoidance of permeation of gasoline, has not been sufficiently satisfactory.

Against this background, Appellants provide a fuel system excellent in gasoline barrier property, heat resistance and impact resistance, and which also (illustratively, when used in forming a tube of, e.g., rubber) has excellent flexibility. Moreover, the fuel system can be provided relatively inexpensively, insuring a high profitability. Appellants have found that by forming the fuel system utilizing a thermoplastic resin and/or a rubber as the body of the fuel system, and providing a coating layer on at least one side of the body, the coating layer being formed by curing an epoxy resin composition including the epoxy resin and the epoxy resin curing agent recited in the present claims, the coating layer containing the amount of the skeletal structure of general formula (1) as in present claim 1; and wherein the coating layer has a gasoline permeability coefficient of  $2 \text{ g} \cdot \text{mm}/\text{m}^2 \cdot \text{day}$  or less at  $60^\circ\text{C}$  in a relative humidity of 60%RH, objectives according to the present invention are achieved. In particular, an excellent gas barrier property is achieved, the fuel system has excellent heat and impact resistance, and bendability, the coating layer has excellent adhesiveness to the body of thermoplastic resin, and the fuel system can be provided relatively inexpensively.

Thus, as described on pages 17, 18, 23 and 24 of Appellants' specification, by utilizing the specified epoxy resin curing agent, and specified epoxy resin, in the

epoxy resin composition which is cured to form the coating layer, the coating layer including the skeletal structure of general formula (1), and at least 30% by weight (of the total weight of the coating layer) being of the skeletal structure of general formula (1), as in the present claims, a good adhesiveness of the coating layer to various materials, high gasoline barrier property, flexibility and heat resistance are achieved.

Note that the multifunctional compound of (B) and the monovalent carboxylic acid of (C), in the present claims, respectively include compounds having at least one acyl group which can form an amide group part by reacting with polyamine to form an oligomer, the multifunctional compound being selected from a specified group of acids and derivatives, and the monovalent carboxylic acids having 1-8 carbon atoms and/or a derivative thereof. As for these components (B) and (C), note the paragraph bridging pages 23 and 24, as well as the sole full paragraph on page 24, of Appellants' specification, describing illustrative specific materials as well as the derivatives.

Gerdes, et al. discloses a coated polymeric article, e.g., a polyethylene substrate, having reduced permeability for fuels, particularly gasoline-type fuels, and characterized by a two component, preferably three component, varnish coat comprising: (a) an epoxy resin, e.g., preferably having an epoxy equivalent weight of about 150-280, (b) an effective amount of a specified amine-based curing agent as set forth in lines 3-11 of column 2, and preferably a third varnish component which is a flexibilizer, e.g., a suitable amount of isocyanate prepolymers, e.g., one based on an isocyanate prepolymer containing ether groups and urethane groups. Note the paragraph bridging columns 1 and 2 of this patent. See also column 2, lines 37-41. This patent discloses that suitable epoxy resins are those containing more than one epoxide group, e.g., 1.5-5, in the monomeric unit. See column 2, lines 56-58. Note also column 2, lines 59-68, for particularly suitable epoxy resins. Note also

column 3, lines 1-35, for curing agents for use in forming the fuel impervious polymeric article of Gerdes, et al.

It is respectfully submitted that Gerdes, et al. requires an amine-based curing agent as set forth in column 2, lines 1-11; and it is respectfully submitted that this reference does not disclose, nor would have suggested, structure as in the present claims, wherein the epoxy resin composition cured to form the coating layer includes an epoxy resin curing agent as in the present claims, comprising a reaction product of (A) and (B) or reaction product of (A), (B) and (C), or wherein the coating layer has the recited gasoline permeability coefficient, or other features of the present invention, including the epoxy resin and skeletal structure of general formula (1) of the coating layer (much less the amount of skeletal structure of general formula (1) in the coating layer).

It is emphasized that Gerdes, et al. does not disclose, nor would have suggested, use of xylylenediamine. It is respectfully submitted that Gerdes, et al. would have neither taught nor would have suggested the skeletal structure of the formula (1), much less amount of 30% by weight or more, based on the weight of the coating layer, of the skeletal structure represented by the formula (1) in the coating layer, and advantages due thereto.

The contention by the Examiner that the disclosure of Gerdes, et al., with respect to the invention described therein, is not limited to the examples, is noted. However, as indicated previously, it is respectfully submitted that nowhere in Gerdes, et al., either in the general description or specific examples, is there a disclosure of the use of xylylenediamine. Certainly, without disclosure of xylylenediamine, amount of the skeletal structure represented by the formula (1) in the coating layer would have neither been disclosed nor would have been suggested by Gerdes, et al.

It is respectfully submitted that Gerdes, et al. teaches that the glycidyl ether of bisphenol A is particularly suitable for the epoxy resin, as set forth in the last paragraph in column 2 of Gerdes, et al. It is respectfully submitted that Gerdes, et al. is completely silent about use of the epoxy resin having a glycidylamine part derived from metaxylylenediamine, or an epoxy resin having a glycidylamine part derived from 1,3-bis(aminomethyl)-cyclohexane, as in the present claims.

Thus, it is respectfully submitted that Gerdes, et al. is deficient with respect to at least each of the following features set forth in the present claims, as well as the combination thereof, providing advantages as discussed herein:

- (1) the coating layer having the specified gasoline permeability coefficient;
- (2) wherein the epoxy resin includes at least one selected from an epoxy resin having a glycidylamine part derived from metaxylylenediamine, and an epoxy resin having a glycidylamine part derived from 1,3-bis(aminomethyl)-cyclohexane;
- (3) wherein the epoxy resin curing agent comprises a reaction product of (A) and (B), or a reaction product of (A), (B) and (C), as in claim 1;  
and/or
- (4) the coating layer contains the skeletal structure of formula (1); and/or
- (5) the coating layer contains such skeletal structure of formula (1) at least in an amount of 30% by weight based on the weight of the coating layer.

The Examiner refers to amount of the claimed formula (1), in connection with blending proportion of the epoxy resin to the epoxy resin curing agent, on page 4, lines 3-6 of the Office Action mailed December 10, 2008. Apparently, reference to such blending proportion is to a description in Gerdes, et al. However, it is emphasized that Gerdes, et al. does not even disclose xylylenediamine. Apparently,



the Examiner agrees with this argument, the Examiner noting that Gerdes, et al. fails to disclose an epoxy curing agent comprising a reaction product of metaxylylenediamine and an acrylic acid derivative which can form an amide by a specified reaction, noting the paragraph bridging pages 2 and 3 of the Office Action mailed December 10, 2008. As Gerdes, et al. does not even disclose use of xylylenediamine, it is respectfully submitted that there is no basis for the conclusion by the Examiner that this reference would contain the claimed formula (1) in the amount of at least 30% by weight.

To the contrary, it is respectfully submitted that from the structure of the Example in Gerdes, et al., set forth in column 5 thereof, and even in light of teachings of other references, as applied in rejecting the present claims, the claimed formula (1) would be contained in an amount much less than 30% in Gerdes, et al., as shown in the following.

Thus, the varnish formulation actually taught in the Example of Gerdes, et al. contains the following ingredients:

- (A) 59 parts by weight of epoxy resin;
- (B) 7 parts by weight of flexibilizer; and
- (C) 34 parts by weight of a mixture of:
  - 7.79 parts by weight of 3-aminomethyl-3,5,5 trimethylcyclohexylamine (diamine 1),
  - 6.38 parts by weight of a mixture of 2,2,4- and
  - 2,4,4-trimethylhexamethylenedamine (diamine 2),
  - 5.67 parts by weight of epoxy resin,
  - 1.70 parts by weight of salicylic acid, and
  - 12.46 parts by weight of benzyl alcohol.

The molecular weight is 170 for diamine 1 ( $C_{10}H_{22}N_2$ ), 158 for diamine 2 ( $C_9H_{22}N_2$ ), and 136 for xylylenediamine ( $C_8H_{12}N_2$ ).

If xylylenediamine is used in place of the diamines 1 and 2 in the same molar amounts, the varnish formulation contains the following ingredients:

- (A) 59 parts by weight of epoxy resin;
- (B) 7 parts by weight of flexibilizer; and
- (C) 34 parts by weight of a mixture of:
  - 6.23 parts by weight  $((7.79/170) \times 136)$  of xylylenediamine in place of the diamine 1,
  - 5.49 parts by weight  $((6.38/158) \times 136)$  of xylylenediamine in place of the diamine 2,
  - 5.67 parts by weight of epoxy resin,
  - 1.70 parts by weight of salicylic acid, and
  - 12.46 parts by weight of benzyl alcohol.

Letting the varnish formulation consist of only the epoxy resin and the amine curing agent for simplification, the content of the claimed formula (1) in a composition corresponding to that in Gerdes, et al., but including xylylenediamine, is calculated as 17% by weight  $(12/(12 + 59) \times 100)$ , which is far lower than the claimed range of 30% by weight or more. It should be noted that the content in the actual formulation in the Example in Gerdes, et al. would be smaller than 17% by weight, because of the presence of other ingredients.

Thus, the content of the claimed structure (1) corresponding to the Example of Gerdes et al., even where xylylenediamine is used, is much smaller than the presently claimed range. It is respectfully submitted that Gerdes, et al. would have neither taught nor would have suggested, and in fact would have taught away from, amount of skeletal structure of general formula (1) as in the present claims.

It is respectfully submitted that the additional teachings of the secondary references as applied by the Examiner would not have rectified the deficiencies of Gerdes, et al., such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Tashiro, et al. discloses epoxy resin compositions having room temperature curability, the curing agent being sufficiently curable even in a wet state and having an improved compatibility with tar. The curing agent disclosed in this patent can be obtained by addition and condensation reactions of three components A, B and C, A being an acrylic or methacrylic acid ester, B being one of slightly water-soluble or insoluble aliphatic amines having a primary amine radical or an amine mixture thereof, and C being (a) a xylylenediamine having a specified structural formula and having both properties of aliphatic amine and aromatic amine, and (b) a 70:30 mixture of metaxylylenediamine and paraxylylenediamine. See column 1, line 59 through column 2, line 16. Note also column 2, lines 17-49, describing how the components A-C of the curing agent are reacted.

Huang, et al. discloses a heat-curable resinous composition comprising polyglycidyl xylylenediamine, obtained by the reaction between xylylenediamine and epichlorohydrin. This patent document discloses that the disclosed material has a relatively low viscosity resulting in a good workability, and gives cured products exhibiting a high heat distortion temperature. Note column 1, lines 6-9 and 61-67. Note also column 4, lines 21-25. Huang, et al. discloses that the polyglycidyl xylylenediamine can be readily cured with the aid of curing agents customarily used for curing of glycidyl compounds, such as aliphatic or aromatic polyamines and organic carboxylic anhydrides. Note column 4, lines 37-41. This patent further discloses that the polyglycidyl xylylenediamine provides an industrial material

exhibiting a low viscosity suitable for adhesives and castings, and a cured product prepared therefrom shows a high heat resistance. See column 5, lines 19-25.

Initially, it is respectfully submitted that the teachings of Gerdes, et al., as applied by the Examiner, would not have been properly combinable with the teachings of either of Tashiro, et al., or of Huang, et al. Thus, it is noted that Gerdes, et al. is directed to a fuel impervious polymeric article, facing the problem of providing such article without a primer or adhesion promoter. In contrast, Tashiro, et al. is directed to an epoxy resin curing agent which is sufficiently curable even in a wet state and having an improved compatibility with tar; and Huang, et al. is directed to heat-curable resin compositions comprising polyglycidyl xylylenediamine, with a relatively low viscosity and high heat distortion temperature, suitable for adhesives and coatings, without disclosure in either of Tashiro, et al. or Huang, et al. of whether or not the composition is permeable to fuel. It is emphasized that Tashiro, et al., and Huang, et al. are silent as to the structures formed having fuel barrier properties. In view of differences in technology of the applied references, and further in view of differences in problems addressed by each of these references, it is respectfully submitted that one of ordinary skill in the art concerned with in Gerdes, et al. would not have looked to the teachings of Tashiro, et al. or of Huang, et al. In other words, it is respectfully submitted that the teachings of these references are directed to non-analogous arts.

In any event, particularly in view of the differences in technology of the applied references, and also in view of differences in problems addressed by each, referred to in the foregoing, it is respectfully submitted that there would have been no proper reason to combine the teachings of these applied references, as applied by the Examiner. Absent such reason, it is respectfully submitted that the combination of

teachings of these references as applied by the Examiner uses impermissible hindsight, i.e., such combination is improper under the guidelines of 35 U.S.C. §103.

In the paragraph bridging pages 3 and 4 of the Office Action mailed December 10, 2008, the Examiner sets forth allegations as to motivation for combining the teachings of the applied references. Emphasizing that Gerdes, et al. is directed to a fuel impervious polymeric article, as a main purpose thereof, while neither of Tashiro, et al. or Huang, et al. discloses gasoline permeability of the materials set forth therein, it is respectfully submitted that the motivation alleged by the Examiner is improper, under the requirements of 35 U.S.C. §103.

Moreover, it is emphasized that the Examiner has utilized a curing agent in Tashiro, et al., ignoring the epoxy resin described therein; and has used a polyglycidyl xylylenediamine in Huang, et al., ignoring other components of the composition described therein. Such use of bits and pieces of the various references applied by the Examiner, ignoring the teachings of the references as a whole, is improper under the requirements of 35 USC 103.

The contention by the Examiner in the last sentence bridging pages 3 and 4 of the Office Action mailed December 10, 2008, that the recitation of the acrylic acid derivative being a derivative that can form an amide by reacting with polyamine “is given little patentable weight as it is directed to a process limitation rather than a structural limitation”, is respectfully traversed. It is respectfully submitted that such recitation in connection with the acrylic acid derivative is a recitation of a property of the multifunctional compound, and must be considered in determining patentability.

It is emphasized that as the epoxy resins curable by the curing agent disclosed therein, Tashiro, et al. discloses only glycidyl ethers of polyhydric phenols or polyhydric alcohols. Note the paragraph bridging columns 2 and 3 of this patent.

It is respectfully submitted that Tashiro, et al. is completely silent with respect to glycidylamine of xylylenediamine.

In addition, it is respectfully submitted that the epoxy resin composition of Tashiro, et al. is to provide a material having improved compatibility with tar (that is, an epoxy paint for tar). It is respectfully submitted that Tashiro, et al. provides no disclosure with respect to gasoline barrier properties of a cured product of the epoxy resin composition described therein. It is respectfully submitted that the teachings of Tashiro, et al., even in combination with the teachings of the other references applied by the Examiner, including Gerdes, et al., would have neither taught nor would have suggested the features of the present invention as discussed previously, including at least features of claim 1 discussed previously.

Similarly, note that the epoxy resin of Huang, et al. is disclosed as an adhesive and casting, Huang, et al. teaching that polyglycidyl xylylenediamines obtained by the reaction between xylylenediamine and epichlorohydrin have a relatively low viscosity resulting in good workability and giving a cured product exhibiting a high heat distortion temperature. To be emphasized is that this reference, also, provides no disclosure with respect to gasoline barrier properties. Thus, the teachings of Huang, et al., even together with the teachings of Gerdes, et al. and Tashiro, et al. would have neither taught nor would have suggested the gas barrier properties achieved by the structures of the present invention, including the gasoline barrier property of the coating layer.

It is respectfully submitted that the Examiner has picked and chosen bits and pieces of each of Tashiro, et al. and of Huang, et al., together with bits and pieces of the teachings of the polymeric article of Gerdes, et al., in coming to a conclusion of obviousness of the presently claimed subject matter. It is respectfully submitted that the only reason for choosing bits and pieces of Gerdes, et al. and of the secondary

references, as applied by the Examiner, is hindsight use of Applicants' disclosure. Such hindsight use of Applicants' disclosure is clearly inappropriate under the requirements of 35 U.S.C. §103.

Moreover, even assuming, arguendo, that the combined teachings of Gerdes, et al., Tashiro, et al. and Huang, et al. would have disclosed the specific materials of the coating layer as in the present claims, the Examiner has provided no proper basis for concluding that the coating layer taught by the references contains skeletal structure represented by the formula (1) in an amount of 30% by weight or more based on the weight of the coating layer. Again, attention is directed to the calculations set forth earlier herein, showing that in the Example in Gerdes, et al. the content of the formula (1) would be smaller than 17% by weight, were xylylenediamine used in place of the diamines 1 and 2 in the same molar amounts in Gerdes, et al. It is respectfully submitted that this would be the sole basis for determining an amount of formula (1) skeletal structure, from the teachings of Gerdes, et al. and/or the combined teachings thereof with teachings of Tashiro, et al., and of Huang, et al., as applied by the Examiner. Clearly, the disclosures of the applied references would have taught away from the amount of the skeletal structure represented by the formula (1) in the coating layer as in the present claims, and advantages thereof.

**Rejection of Claim 23 Under 35 U.S.C. §103(a) As Unpatentable Over the U.S. Patents to Gerdes, et al. (No. 4,719,135) In View Of Tashiro, et al. (No. 3,704,229) and Watanabe, et al. (No. 5,474,853)**

It is respectfully submitted that the combined teachings of Gerdes, et al., Tashiro, et al. and Watanabe, et al. would have neither taught nor would have suggested the subject matter claimed in claim 23.

Gerdes, et al. and Tashiro, et al. have been previously discussed.

Watanabe, et al. discloses a resin composition and a molded article formed therefrom, which is excellent in heat resistance, rigidity, surface smoothness and adhesion to a coating composition, the resin composition comprising an MX nylon which is formed from xylylenediamine and specified aliphatic dibasic acid, a modified polyphenylene ether resin, a fibrous inorganic filler having an average fiber diameter of 10  $\mu\text{m}$  or less, a powdery inorganic filler having an average particle diameter of 10  $\mu\text{m}$  or less, an epoxy resin, and a copper compound and/or a powdery phenolic resin. Note column 2, line 57, through column 3, line 20. This patent discloses a lamp reflector obtained by molding this resin composition and coating the composition with a metal. See column 3, lines 21-24.

It is emphasized that Watanabe, et al. discloses a resin composition, without any disclosure therein of a fuel system, and, in particular, without any disclosure therein of a coating layer which is a barrier layer for gasoline. In particular, it is respectfully submitted that Watanabe, et al. provides no disclosure at all with respect to the resin composition described therein being used in an article having a barrier layer for gasoline. It is respectfully submitted that one of ordinary skill in the art concerned with in Gerdes, et al., would not have looked to the teachings of Watanabe, et al., in view of differences in technology and differences in problems addressed by the two references.

Even assuming, arguendo, that the teachings of Gerdes, et al., Tashiro, et al. and Watanabe, et al. were properly combinable, it is respectfully submitted that such combined teachings would have neither disclosed nor would have suggested such a fuel system as in present claim 23, having the recited coating layer with the gasoline permeability coefficient thereof, formed by curing an epoxy resin composition including the epoxy resin and the epoxy resin curing agent as in the present claims, and, moreover, where the coating layer contains skeletal structure represented by



the formula (1) in the present claims in an amount thereof as in the present claims,  
and advantages due thereto.

### **CONCLUSION**

It is respectfully submitted that the combined teachings of the references as applied by the Examiner would have neither disclosed nor would have suggested the presently claimed subject matter. Initially, it is respectfully submitted that the teachings of Tashiro, et al. and of Huang, et al., or the teachings of Tashiro, et al, and Watanabe, et al., would not have been properly combinable with the teachings of Gerdes, et al. It is respectfully submitted that these references are directed to non-analogous arts, being from different fields of technology and addressing different problems. Only through hindsight use of Applicants' disclosure, which of course is improper under the requirements of 35 U.S.C. §103, would one of ordinary skill in the art have combined the teachings of Tashiro, et al. and of Huang, et al., or of Tashiro, et al. and Watanabe, et al., with the teachings of Gerdes, et al.

Furthermore, even assuming, arguendo, that the teachings of the references as applied by the Examiner were properly combinable, such combined teachings would have neither disclosed nor would have suggested the presently claimed fuel system, having the recited component and coating layer thereon, the coating layer being formed by curing an epoxy resin composition including an epoxy resin and epoxy resin curing agent, including (but not limited to) (1) wherein the coating layer has a gasoline permeability coefficient of  $2 \text{ g} \cdot \text{mm}/\text{m}^2 \cdot \text{day}$  or less at  $60^\circ\text{C}$  and a relative humidity of 60% RH; (2) wherein the epoxy resin includes at least one selected from the epoxy resin having a glycidylamine part derived from metaxylylenediamine and an epoxy resin having a glycidylamine part derived from 1,3-bis(aminomethyl)-cyclohexane; (3) wherein the epoxy resin curing agent comprises the reaction product of the components (A) and (B), or a reaction product of the components (A), (B) and (C); and (4) wherein the coating layer contains the skeletal structure of formula (1), at least in an amount of 30% by weight based on the

weight of the coating layer, and advantages achieved by such structure, and other features of the present invention as in the dependent claims, as discussed previously, and advantages thereof.

Furthermore, even assuming, arguendo, that the teachings of the applied references would have established a prima facie case of obviousness, the evidence of record (in Appellants' specification and in the Declaration submitted September 2, 2008) establishes unexpectedly better results, including reduced gasoline permeability and reduced gasoline permeability before and after bending, achieved by the present invention as compared with the closest prior art.

In view of the foregoing, it is respectfully submitted that the Examiner errs in the Final rejection of claims in the Office Action mailed December 10, 2008; and it is respectfully requested that such error be corrected by reversing the Examiner's Final rejection in due course.

The Appeal Brief fee in the amount of \$540.00 is attached hereto.

Please charge any shortage in fees due in connection with the filing of this paper to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (case No. 396.42795X00), and please credit any excess fees to such Deposit Account.

Respectfully submitted,

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### **CLAIMS APPENDIX**

1. A fuel system comprising a fuel vessel, molded parts for the fuel vessel and/or a tube for a fuel in which bodies thereof are constituted from a thermoplastic resin and/or a rubber, wherein:

a coating layer is formed on the surfaces in at least one sides of the insides and the outsides of the fuel vessel body, the molded part bodies for the fuel vessel and/or the tube body for a fuel or at least one of connected parts in these bodies;

the above coating layer is formed by curing an epoxy resin composition comprising an epoxy resin and an epoxy resin curing agent as principal components;

the above coating layer, which is barrier layer for gasoline, has a gasoline permeability coefficient of  $2 \text{ g}\cdot\text{mm}/\text{m}^2\cdot\text{day}$  or less at  $60^\circ\text{C}$  and a relative humidity of 60% RH;

the epoxy resin described above comprises at least one selected from an epoxy resin having a glycidylamine part derived from metaxylylenediamine, and an epoxy resin having a glycidylamine part derived from 1,3-bis(aminomethyl)-cyclohexane; and

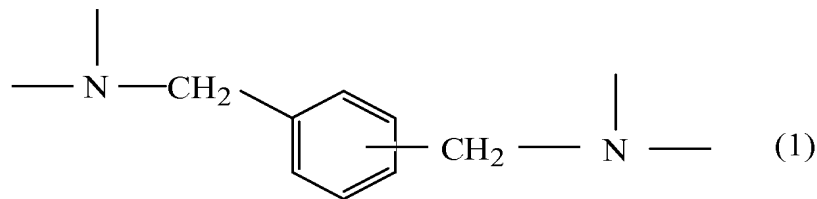
the epoxy resin curing agent comprises a reaction product of (A) and (B) or a reaction product of (A), (B) and (C):

(A) metaxylylenediamine or paraxylylenediamine,

(B) a multifunctional compound having at least one acyl group which can form an amide group part by reacting with polyamine to form an oligomer, the multifunctional compound being selected from the group consisting of acrylic acid, methacrylic acid, and derivatives of acrylic acid, methacrylic acid, maleic acid, fumaric acid, succinic acid, malic acid, tartaric acid, pyromellitic acid and trimellitic acid, and

(C) monovalent carboxylic acid having 1 to 8 carbon atoms and/or a derivative thereof; and

the coating layer contains skeletal structure represented by the following formula(1)



in an amount of 30% by weight or more based on the weight of the coating layer.

2. The fuel system as described in claim 1, wherein the gasoline permeability coefficient is  $0.2 \text{ g}\cdot\text{mm}/\text{m}^2\cdot\text{day}$  or less.
6. The fuel system as described in claim 1, wherein the epoxy resin described above comprises the resin having a glycidylamine part derived from metaxylylenediamine as a principal component.
8. The fuel system as described in claim 1, wherein the multifunctional compound (B) described above is acrylic acid, methacrylic acid and/or a derivative thereof.
9. The fuel system as described in claim 1, wherein the coating layer is formed on any surface of the inside and the outside of the fuel vessel body constituted from a thermoplastic resin at an area rate of 50 to 100%.
10. The fuel system as described in claim 9, wherein the thermoplastic resin constituting the fuel vessel body is a polyolefin resin.

11. The fuel system as described in claim 10, wherein the thermoplastic resin constituting the fuel vessel body is a polyethylene resin.

12. The fuel system as described in claim 1, wherein the coating layer is formed on at least one sides of the insides and the outsides of the molded part bodies for the fuel vessel constituted from a thermoplastic resin.

13. The fuel system as described in claim 12, wherein the thermoplastic resin constituting the molded part bodies for the fuel vessel is a polyolefin resin.

14. The fuel system as described in claim 13, wherein the thermoplastic resin constituting the molded part bodies for the fuel vessel is a high density polyethylene resin.

15. The fuel system as described in claim 1, wherein the tube comprises the tube body molded from a thermoplastic resin and/or a rubber and the coating layer formed on an external surface and/or an internal surface of the above tube.

16. The fuel system as described in claim 15, wherein the thermoplastic resin of the tube body is at least one selected from a polyolefin resin, a polyurethane resin, a polyamide resin, a polyester resin, an acryl resin and a vinyl resin which have flexibility.

17. The fuel system as described in claim 16, wherein a blending proportion of the epoxy resin curing agent to the epoxy resin contained in the epoxy resin composition in the coating resin layer of the tube body falls in a range of 1.2 to

3.0 in terms of an equivalent ratio (active hydrogen/epoxy group) of active hydrogen contained in the epoxy resin curing agent to an epoxy group contained in the epoxy resin.

18. The fuel system as described in claim 1, wherein the coating layer is formed on at least one of the connected parts of the body selected from the fuel vessel body, the molded part bodies for the fuel vessel and the tube body for a fuel.

19. The fuel system as described in claim 1, wherein a reaction mole ratio of (A) to (B), or (A) to (B) and (C), is within a range of 0.3 to 0.97 in terms of number of amino groups in (A) to the number of reactive functional groups in (B), or number of amino groups in (A) to total number of reactive functional groups in (B) and (C).

20. The fuel system as described in claim 1, wherein a blending proportion of the epoxy resin curing agent to the epoxy resin contained in the epoxy resin composition in the coating resin layer of the tube body falls in a range of 1.2 to 3.0 in terms of an equivalent ratio (active hydrogen/epoxy group) of active hydrogen contained in the epoxy resin curing agent to an epoxy group contained in the epoxy resin, and wherein a blending proportion of the epoxy resin curing agent to the epoxy resin contained in the epoxy resin composition in the coating resin layer of the fuel vessel of the molded part bodies falls in a range of 0.5 to 5.0 in terms of said equivalent ratio.

21. The fuel system as described in claim 1, wherein a thickness of said coating layer is in a range of 1 to 200 $\mu$ m.

22. The fuel system as described in claim 1, wherein said multifunctional compound is selected from the group consisting of said derivatives.

23. The fuel system as described in claim 1, wherein said epoxy resin includes an epoxy resin having a glycidylamine part derived from 1,3-bis(aminomethyl)-cyclohexane.

24. The fuel system as described in claim 1, wherein said gasoline permeability coefficient of said coating layer is  $0.02 \text{ g}\cdot\text{mm}/\text{m}^2\cdot\text{day}$  or less.

25. The fuel system as described in claim 1, wherein a number average molecular weight of said epoxy resin is in a range of 80 to 4000.



**EVIDENCE APPENDIX**

the tube body; DFT is a thickness (mm) of the coating layer; and P is a gasoline permeability coefficient ( $\text{g}\cdot\text{mm}/\text{m}^2\cdot\text{day}$ ) of the coating layer.

(3) Gasoline permeability of the tube after bending treatment (10 times) (Examples 4 to 8 and Comparative Examples 2 to 4)

A test piece (length: 500 mm, inner diameter: 24 mm and thickness: 5 mm) obtained from the tube prepared was subjected 10 times to bending treatment. After the treatment, the gasoline permeability coefficient ( $\text{g}\cdot\text{mm}/\text{m}^2\cdot\text{day}$ ) was determined by the same method as the method for evaluating a gasoline permeability coefficient of the untreated product.

#### Example 1

Prepared was a methanol/ethyl acetate = 1 : 1 solution (solid matter concentration: 30 % by weight) containing 44 parts by weight of the epoxy resin curing agent A and 50 parts by weight of an epoxy resin having a glycidylamine part derived from metaxylylenediamine (TETRAD-X, manufactured by Mitsubishi Gas Chemical Co., Ltd.), and 0.02 part by weight of an acryl base wetting agent (BYK381, manufactured by Bic Chemie Co., Ltd.) and stirred well to obtain a coating liquid. This coating liquid

was coated on high density polyethylene (HDPE) having a thickness of 100  $\mu$ m by means of a bar coater No. 24 and dried at 120°C for 10 minutes, and then it was further cured at 180°C for 10 minutes, whereby a coated film was obtained. The coating layer had a thickness of 10  $\mu$ m. A gasoline permeability coefficient of the coated film thus obtained was determined. The result thereof is shown in Table 1. The skeletal structure represented by Formula (1) contained in the above coating layer accounted for 54.1 % by weight.

#### Example 2

A coated film was prepared and evaluated by the same methods as in Example 1, except that 72 parts by weight of the epoxy resin curing agent B was substituted for the epoxy resin curing agent A. The result thereof is shown in Table 1. The skeletal structure represented by Formula (1) contained in the coating layer accounted for 56.5 % by weight.

#### Example 3

A coated film was prepared and evaluated by the same methods as in Example 1, except that 78 parts by weight of the epoxy resin curing agent C was

substituted for the epoxy resin curing agent A. The result thereof is shown in Table 1. The skeletal structure represented by Formula (1) contained in the coating layer accounted for 56.9 % by weight.

#### Comparative Example 1

A film of 100  $\mu$  m comprising EVOH (ethylene content: 32 mole %, saponification: 99.6 %) was evaluated for a gasoline permeability coefficient. The result thereof is shown in Table 1.

Table 1

	Gasoline permeability coefficient (g·mm/m <sup>2</sup> ·day)
Example 1	0.006
Example 2	0.006
Example 3	0.004
Comparative Example 1	0.20

#### Example 4

An acrylonitrile-butadiene rubber was molded into a tube having an inner diameter of 24 mm and a thickness of 5 mm, and this was cut to a length of 500 mm to obtain a tube body. Prepared was a methanol/ethyl acetate = 1 : 1 solution (solid matter concentration: 30 % by weight) containing 50 parts by

weight of the epoxy resin having a glycidylamine part derived from metaxylylenediamine (TETRAD-X, manufactured by Mitsubishi Gas Chemical Co., Ltd.) and 115 parts by weight of the epoxy resin curing agent A, and 0.02 part by weight of the acryl base wetting agent (BYK381, manufactured by Bic Chemie Co., Ltd.) and stirred well to obtain a resin solution. One end face of the tube body described above was sealed with an aluminum matter (aluminum-deposited film), and this resin solution was filled into the tube body and immediately discharged, whereby the resin solution was coated onto the inner face of the tube body. After discharging the resin solution, the aluminum matter was detached from the end face of the tube body, and the resin solution was cured at 80°C for 10 minutes and then at 120°C for 15 minutes to form a coating layer. The coating layer had a thickness of 10  $\mu$ m. The tube in which the coating layer was formed was evaluated for a gasoline barrier property and a gasoline barrier property after bending (a gasoline permeability coefficient of the coating layer, a gasoline permeability of the tube and a gasoline permeability of the tube after the bending treatment (10 times)). The results thereof are shown in Table 2. The skeletal structure

represented by Formula (1) contained in the above coating layer accounted for 61.4 % by weight.

#### Example 5

A tube was prepared by the same method as in Example 4, except that 132 parts by weight of the epoxy resin curing agent B was substituted for the epoxy resin curing agent A, and the gasoline barrier property and the gasoline barrier property after bending were evaluated. The results thereof are shown in Table 2. The skeletal structure represented by Formula (1) contained in the above coating layer accounted for 59.3 % by weight.

#### Example 6

A tube was prepared by the same method as in Example 4, except that 163 parts by weight of the epoxy resin curing agent C was substituted for the epoxy resin curing agent A, and the gasoline barrier property and the gasoline barrier property after bending were evaluated. The results thereof are shown in Table 2. The skeletal structure represented by Formula (1) contained in the above coating layer accounted for 60.5 % by weight.

#### Example 7

A tube was prepared by the same method as in Example 4, except that 110 parts by weight of the epoxy resin curing agent D was substituted for the epoxy resin curing agent A, and the gasoline barrier property and the gasoline barrier property after bending were evaluated. The results thereof are shown in Table 2. The skeletal structure represented by Formula (1) contained in the above coating layer accounted for 66.5 % by weight.

#### Example 8

A tube was prepared by the same method as in Example 4, except that 140 parts by weight of the epoxy resin curing agent E was substituted for the epoxy resin curing agent A, and the gasoline barrier property and the gasoline barrier property after bending were evaluated. The results thereof are shown in Table 2. The skeletal structure represented by Formula (1) contained in the above coating layer accounted for 59.4 % by weight.

#### Comparative Example 2

A nylon-12 resin was used as a barrier resin layer, and an acrylonitrile-butadiene rubber was used

as an external layer to mold them into a tube having an inner diameter of 24 mm, a thickness of 0.1 mm in the barrier resin layer and a thickness of 5 mm in the external layer by means of an injection molding machine. This tube was cut to a length of 500 mm, and the gasoline barrier property and the gasoline barrier property after bending were evaluated. The result thereof is shown in Table 2.

#### Comparative Example 3

A tube was prepared by the same method as in Comparative Example 2, except that a copolymer resin of vinylidene fluoride, propylene hexafluoride and ethylene tetrafluoride was used as the barrier resin layer, and the gasoline barrier property and the gasoline barrier property after bending were evaluated. The result thereof is shown in Table 2.

#### Comparative Example 4

A tube was prepared by the same method as in Example 4, except that 33 parts by weight of the epoxy resin curing agent F was substituted for the epoxy resin curing agent A, and the gasoline barrier property and the gasoline barrier property after bending were evaluated. The result thereof is shown



in Table 2.

Table 2

	Gasoline permeability coefficient of coating layer (g·mm/m <sup>2</sup> ·day)	Gasoline permeability of tube (g/m <sup>2</sup> ·day)	Gasoline permeability of tube after bending (g/m <sup>2</sup> ·day)
Example 4	0.010	1.0	1.1
Example 5	0.009	0.9	1.0
Example 6	0.009	0.9	1.0
Example 7	0.012	1.2	1.2
Example 8	0.010	1.0	1.1
Comparative Example 2	-	150	150
Comparative Example 3	-	14	100
Comparative Example 4	0.015	1.5	10

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

**Applicant : TAKAAKI KUTSUNA, ET. AL.**

**Serial No. : 10/9602,637**

**Filed : June 25, 2003**

**For : FUEL SYSTEM HAVING EXCELLENT GASOLINE BARRIER  
PROPERTY**

**Art Unit & Examiner: 1794, PATTERSON, MARC A**

**DECLARATION UNDER 37 C.F.R. 1.132**

**Honorable Commissioner of Patents and Trademarks  
Washington, D.C. 20231**

**Sir:**

**Now comes Shinichi YONEHAMA who deposes and states:**

- 1. That I am a graduate of Kanazawa University and (received master degree of Engineering in the year of 1993.)**
- 2. That I have been employed by Mitsubishi Gas Chemical Company Inc. of 5-2, Marunouchi 2-chome, Chiyoda-ku, Tokyo 100-8324, Japan for years since 1993 as a researcher in the field of Polymer.**
- 3. That I have a good knowledge of the English language and have read and understood the application papers and the Examiner's Official Action as well as the reference cited therein in the prosecution of the above identified patent application; and**
- 4. The following experiments were carried out by me.**

**Additional Comparative Examples**

- 1. Curing agent of Tashiro et al was prepared according to Example 1 of US3,704,229.**

**2. Additional Comparative Example 1**

**Prepared was a methanol/ethyl acetate = 1 : 1 solution (solid matter**

concentration: 30 % by weight) containing 40 parts by weight of the above curing agent and 60 parts by weight of an epoxy resin Epikote 828 (Shell) and stirred well to obtain a coating liquid. This coating liquid was coated on high density polyethylene (HDPE) having a thickness of 100  $\mu\text{m}$  by means of a bar coater No. 24 and dried at 120°C for 10 minutes, and then it was further cured at 180°C for 10 minutes, whereby a coated film was obtained. The coating layer had a thickness of 10  $\mu\text{m}$ . A gasoline permeability coefficient of the coated film thus obtained was determined. The result thereof is shown in Table A.

### 3. Additional Comparative Example 2

According to Example 4, an acrylonitrile-butadiene rubber was molded into a tube having an inner diameter of 24 mm and a thickness of 5 mm, and this was cut to a length of 500 mm to obtain a tube body.

Prepared was a methanol/ethyl acetate = 1 : 1 solution (solid matter concentration: 30 % by weight) containing 40 parts by weight of the above curing agent and 60 parts by weight of an epoxy resin Epikote 828 (Shell) and stirred well to obtain a resin solution.

One end face of the tube body described above was sealed with an aluminum matter (aluminum-deposited film), and the resin solution was filled into the tube body and immediately discharged, whereby the resin solution was coated onto the inner face of the tube body. After discharging the resin solution, the aluminum matter was detached from the end face of the tube body, and the resin solution was cured at 80°C for 10 minutes and

then at 120°C for 10 minutes to form a coating layer. The coating layer had a thickness of 10  $\mu\text{m}$ . The tube in which the coating layer was formed was evaluated for a gasoline barrier property and a gasoline barrier property after bending (a gasoline permeability coefficient of the coating layer, a gasoline permeability of the tube and a gasoline permeability of the tube after the bending treatment (10 times)). The results thereof are shown in Table A.

Table A

Comparison of results of Additional Comparative Examples with those of Example 1 and 4 of the present invention

	thickness of coating layer	Gasoline permeability coefficient	Gasoline permeability coefficient of layer	Gasoline permeability of tube	Gasoline permeability of tube after bending
	$\mu\text{m}$	$\text{g}\cdot\text{mm}/\text{m}^2\cdot\text{day}$	$\text{g}\cdot\text{mm}/\text{m}^2\cdot\text{day}$	$\text{g}/\text{m}^2\cdot\text{day}$	$\text{g}/\text{m}^2\cdot\text{day}$
Example 1	10	0.006			
Example 4	10		0.010	1.0	1.1
Additional Comparative Example 1	10	0.25			
Additional Comparative Example 2	10		0.42	33	94

I declare further that all statements made herein of my own

knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Shinichi Yonehama  
Shinichi YONEHAMA

August 11, 2008  
Date

**RELATED PROCEEDINGS APPENDIX**

None.